

REMARKS

Claims 1-47 are pending. Claims 23-47 have been withdrawn. Claims 6-7, 9-13, and 16-18 are amended herein to correct typographical errors and for clarification. No new matter has been added by virtue of the amendments, support for the amendments being found in the original claims and throughout the originally filed specification, claims, and figures.

1. Claim Objections

Claim 18 is objected to. The Office requests that applicants incorporate a list of photoinitiators into the claim. Applicants have amended claim 18 as requested. Reconsideration and withdrawal of the objection is requested.

2. 35 U.S.C. 112 Rejections

Claims 6-13 and 16-18 are rejected under 35 U.S.C. 112, second paragraph. The Office indicates that there is insufficient antecedent basis for "the hydrophobic group" in line 1 of claim 6 and in claim 10, and for "the photoinitiator" in claim 16. Applicants have amended the claims as requested. Reconsideration and withdrawal of the rejections is respectfully requested.

3. 35 U.S.C. 102/103 Rejections

Claims 1-6, 9-14, and 20 are rejected under 35 U.S.C. 102(a) or, alternatively, under 35 U.S.C. 103(a) over Steuck et al (US 4,618,533).

Applicants respectfully traverse.

Applicants claim, in independent claim 1, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules. Each difunctional surface-modifying molecule comprises a hydrophobic portion associated with the substrate and a hydrophilic portion. The surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane.

Applicants' porous membrane is made hydrophilic by cross-linking with a judiciously selected hydrophilic difunctional monomer. The difunctional monomer comprises a hydrophobic portion and a hydrophilic portion. These monomers preferentially absorb to the membrane via the hydrophobic portions, which initiates polymerization on the membrane rather than across pores. The hydrophobic membranes thus formed can withstand repeated cycles of wetting and drying, and provide greater liquid flow rates per unit area and high particle retention. In particular, the liquid flow rates of the treated membranes are substantially the same, and may even be equal to, those of the untreated membrane. Further, by cross-linking the membrane with a judiciously selected hydrophilic difunctional monomer, much less reagent is required for hydrophilization. Reducing the amount of reagents results in less pore plugging and reduced down stream washing requirements.

Applicants note that in the context of monomers for polymerization, the di-functional monomer is a molecule that can be functionalized (polymerized) at two locations on the same molecule. This is the olefinic double bond that can polymerize in the presence of free radicals generated from a radical initiator. This does not include other functional groups that could not be involved in radical polymerization (e.g. an ester group). Thus, the di-functional monomers refer to molecules that contain two olefinic double bonds.

Steuck describes a conventional hydrophilization method. A relatively large quantity of mono-functional hydrophilic monomer is used (hydroxyl propyl acrylate, only one olefinic double bond for polymerization per molecule). A smaller quantity of di-functional monomer (tetraethylene glycol diacrylate) is used for cross-linking. The examples show significant weight gain accompanied with water permeability reduction (pore blockage) after hydrophilization treatment.

The di-functional monomer used by Steuck, tetraethylene glycol diacrylate, does not contain a hydrophobic portion as recited in applicants' claim 1. In fact, example 2 of applicants' disclosure demonstrates that polyethylene glycol (400) diacrylate (Sartomer SR 344), which is similar in structure to Steuck's monomer, does not provide preferential adsorption and could not provide adequate hydrophilization under reduced concentration conditions. Steuck clearly does

not teach or suggest applicants' composite porous membranes comprising a hydrophobic substrate coated with difunctional surface-modifying molecules in accordance with claim 1. Further, Steuck does not teach or suggest applicants' technique (flow through method) for hydrophilization. Still further, Steuck does not teach or suggest preferential adsorption or that the presence of a hydrophobic section can provide preferential adsorption.

Accordingly, claim 1 is patentable over Steuck. Claims 2-6, 9-14, and 20 depend from claim 1 and, likewise, are patentable over Steuck. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 1-6, 9-14, and 16-20 are rejected under 35 U.S.C. 102(b) or, alternatively, under 35 U.S.C. 103(a) over Wang et al (US 5,137,633).

Applicants respectfully traverse.

Wang describes an extension of the conventional hydrophilization method (e.g. Steuck) that includes charged groups of the coated membrane. A cationic polyamine epichlorohydrin resin is included in the treatment solution and, after radical initiated polymerization, the modified membrane contains a positive charged group on its surface. The small amount of cross-linking di-functional monomer that was used, tetraethylene glycol diacrylate, does not contain a hydrophobic section as discussed above with relation to Steuck. Further, nowhere does Wang teach or suggest preferential adsorption, made possible by the inclusion of a hydrophobic section in the monomer, so as to prevent pore blockage. Clearly, Wang does not teach or suggest applicants' composite porous membranes comprising a hydrophobic substrate coated with difunctional surface-modifying molecules in accordance with claim 1. Further, Wang does not teach or suggest applicants' technique (flow through method) for hydrophilization.

Accordingly, claim 1 is patentable over Wang. Claims 2-6, 9-14, and 16-20 depend from claim 1 and, likewise, are patentable over Wang. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 10-19 are rejected under 35 U.S.C. 102(b) or, alternatively, under 35 U.S.C. 103(a) over Ying et al (US 6,183,901) and "UV Refinish Primer and Clear Coat".

Applicants respectfully traverse.

Ying describes the use of an UV cured polymer coating to increase the flexibility and toughness of a microporous pseudo-boehmite battery separator. The pseudo-boehmite is a hydrated aluminum oxide layer with very small pore structures (2 – 30 nm). The protective polymer coating is adjacent to the pseudo-boehmite layer (column 3, line 46) but it does not penetrate the internal pore structure of the pseudo-boehmite layer (column 21, lines 53-56). Ying does not teach or suggest hydrophobic-hydrophobic interaction between pseudo-boehmite (hydrated aluminum oxides) and the polymer of the protective coating. Further, Ying does not teach or suggest preferential adsorption, made possible by the inclusion of a hydrophobic section in the monomer, so as to prevent pore blockage. Applicants further note that Ying requires flexibility and toughness, which necessitate a relatively thick one-sided coating. Applicants' flow through and soaking techniques could not be used to yield such one-sided coatings. "UV Refinish Primer and Clear Coat" does not remedy the above-noted deficiencies in Ying.

Accordingly, claim 1 is patentable over Ying and "UV Refinish Primer and Clear Coat". Claims 10-19 depend from claim 1 and, likewise, are patentable over Ying and "UV Refinish Primer and Clear Coat". Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 20 is rejected under 35 U.S.C. 103(a) over Ying et al (US 6,183,901) and Hoshi et al (US 6,299,653).

Applicants respectfully traverse for the reasons set forth above regarding Ying. As set out, Ying does not teach or suggest hydrophobic-hydrophobic interaction between pseudo-boehmite (hydrated aluminum oxides) and the polymer of the protective coating. Further, Ying

does not teach or suggest preferential adsorption, made possible by the inclusion of a hydrophobic section in the monomer, so as to prevent pore blockage. Further, Ying does not teach or suggest applicants' technique (flow through method) for hydrophilization.

Applicants respectfully submit, in relation to Hoshi, that natural polyvinylidene fluoride (PVDF) polymer is not ionically conductive. Its electrical resistivity is greater than 10^{14} ohm-cm as measured according to ASTM D257 method (Solef brochure from Solvay S.A., KYNAR brochure from Elf Atochem). Only when an electrolytic solution is present in a porous PVDF membrane does the PVDF membrane become conductive. In fact, most of the polymers mentioned by Hoshi are not conductive in their pure state. Only polymers that have ionic groups in their pure state are conductive. Those without ionic groups will need impregnation of an electrolyte to become conductive.

In sum, Ying and Hoshi do not teach or suggest applicants' composite porous membranes comprising a hydrophobic substrate coated with difunctional surface-modifying molecules in accordance with claim 1, wherein preferential adsorption, made possible by the inclusion of a hydrophobic section in the monomer, prevents pore blockage.

Accordingly, claim 1 is patentable over Ying and Hoshi. Claim 20 depends from claim 1 and, likewise, is patentable over Ying and Hoshi". Reconsideration and withdrawal of the rejection is respectfully requested.

CONCLUSION

In view of the foregoing, applicants request reconsideration and allowance of claims 1-22.

It is believed that no fees are required for consideration of this response. However, if for any reason the fee paid is inadequate or credit is owed for any excess fee paid, the Office is hereby authorized and requested to charge Deposit Account No. **04-1105**.

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Respectfully submitted,



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